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A10857GB-RAL

0306033.2

2. Patent application number

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3. Full name, address and postcode of the or of each applicant *(underline all surnames)*

Paul MARRIOTT
66 Jersey Close
Church Hill North
Redditch
Worcestershire B98 9LT

Patents ADP number *(if you know it)*

If the applicant is a corporate body, give the country/state of its incorporation

8419707001

4. Title of the invention

INTRUSION DETECTOR

5. Name of your agent *(if you have one)*

Forrester Ketley & Co.

"Address for service" in the United Kingdom to which all correspondence should be sent *(including the postcode)*

Chamberlain House
Paradise Place
Birmingham
B3 3HP

Patents ADP number *(if you know it)*

133005

6. If you are declaring priority from one or more earlier patent applications, give the country and the date of filing of the or of each of these earlier applications and *(if you know it)* the or each application number

Country

Priority application number
*(if you know it)*Date of filing
(day / month / year)

United Kingdom

0215611.5

5 July 2002

7. If this application is divided or otherwise derived from an earlier UK application, give the number and the filing date of the earlier application

Number of earlier application

Date of filing
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- a) any applicant named in part 3 is not an inventor, or
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Claim(s)

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Abstract

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Drawing(s)

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Statement of inventorship and right to grant of a patent (Patents Form 7/77)

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Request for substantive examination
(Patents Form 10/77)Any other documents
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11.

I/We request the grant of a patent on the basis of this application.

Signature

Forrester Kelley & Co.

Date

17 March 2003

12. Name and daytime telephone number of person to contact in the United Kingdom

R A Lockey
0121 236 0484

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DUPLICATE

PATENTS ACT 1977

A10857GB

Title: Intrusion Detector

Description of Invention

This invention relates to an intrusion detector for a vehicle, particularly but not exclusively to an intrusion detector for a vehicle comprising a trailer for a tractor trailer combination, and also to a vehicle comprising an intrusion detector.

When a vehicle is adapted to transport goods, it is desirable that the vehicle be secured against unauthorised entry, whether for the purposes of theft for concealing a person therein, or otherwise. It is known to seal vehicle doors, such that it is apparent if the doors have been opened, but it requires periodic inspection of the seal to check that it is intact, and where it is desirable for a vehicle to be repeatedly opened, for example for inspection or loading such a seal may not be appropriate. It is also known to use hand held carbon dioxide probes to check a compartment of the vehicle for the presence of carbon dioxide from human respiration, but again such checks may only be made at widely separated intervals, and only on a small proportion of all possible vehicles, for example of vehicles passing through a customs post.

An aim of the invention is to provide a new or improved intrusion detector for a vehicle.

According to a first aspect of the invention, we provide an intrusion detector for a vehicle, the detector being attachable to the vehicle, wherein the intrusion detector comprises a carbon dioxide detector responsive to the presence of carbon dioxide in a compartment of the vehicle, and wherein the intrusion detector is responsive to the proportion of carbon dioxide in the compartment and is operable to generate an alarm in accordance with the proportion of carbon dioxide in the compartment.

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The vehicle may comprise a trailer for a tractor-trailer combination.

The intrusion detector may be adaptable to be mounted on the vehicle and wherein may be duct is provided whereby air from the compartment may be passed to the carbon dioxide detector.

The intrusion detector may comprise a fan to pass air from the compartment to the carbon dioxide detector.

The intrusion detector may be connectable to a power supply of the vehicle and may further comprise a battery which may be charged by the power supply.

The intrusion detector may be operable to generate an alarm if the proportion of carbon dioxide in the compartment rises by a selected proportion or amount.

Alternatively the intrusion detector may be operable to generate an alarm if the proportion of carbon dioxide in the compartment exceeds a selected level.

The selected level of carbon dioxide may be at least 2500 ppm, and preferably at least 3500 ppm, and most preferably at least 2000 ppm.

The alarm may comprise at least one of an audible alarm, a visual alarm, and the transmission of an alarm message.

The intrusion detector may comprise an auxiliary detector responsive to the presence of a person in the component.

The auxiliary detector may be a PIR detector or a microwave detector.

According to a second aspect of the invention, we provide a vehicle comprising an intrusion detector.

The vehicle may comprise a trailer and the intrusion detector may be mounted on a outer surface of the vehicle.

Where the intrusion detector comprises an auxiliary detector the auxiliary detector may be located in the compartment.

An embodiment of the invention will now be described by way of example only with reference to the accompanying drawings wherein;

Figure 1 is a diagrammatic illustration of a vehicle provided with an intrusion detector embodying the present invention.

Figure 2 is a perspective view of an intrusion detector embodying the present invention.

Figure 3 is a side view of the intrusion detector of Figure 2.

Figure 4 is a diagrammatic illustration of the intrusion detector of Figure 2.

Figure 5 is an exploded perspective view of a further intrusion detector embodying the present invention.

Figure 6 is a section through the intrusion detector of Figure 5 when installed on a vehicle bulk head, and,

Figure 7 is an end view of part of the intrusion detector of Figure 5.

Referring now to Figure 1, a vehicle is shown comprising a trailer 10. In this example, the trailer is conventional and intended to be drawn by a tractor 11 having a cab 11a. The trailer 10 is provided with an intrusion detector 12 embodying the present invention. In this example, the intrusion detector 12 is mounted externally of the trailer 10 at a position located towards the top of a forward wall 10a of the trailer 10. As seen in Figure 1, the trailer 10 and tractor 11 are connected in conventional manner by conventional electrical and pneumatic connections 13 as shown, and the intrusion detector 12 may be connected to an appropriate supply of power from the tractor 11. The trailer 10 comprises a compartment 10b, comprising a closed volume in which goods may be carried.

Referring now to Figures 2 to 4, the intrusion detector 12 comprises a case 14 which is resistant to attempt to remove or damage the intrusion detector 12. In the present example, the case 14 comprises a cover 15 comprising stainless steel attached to a galvanised steel chassis 16. The cover 15 is attached to the chassis 16 by suitable tamper resistant fixings 17, in the present example tamper resistant screws. The case 14 is preferably weather proof. A

tamper switch may be provided connected to the cover 15 to cause the alarm 25 to be activated when the cover 15 is removed.

The intrusion detector 12 comprises a duct 18 which extends into the interior of the compartment where intrusion detection is required, in the present example into the compartment 10b of the trailer 10. In the present example, the intrusion detector is further provided with a fan 19 which draws air in through the duct 18 and passes the air over a carbon dioxide detector 20. The intrusion detector 12 comprises a suitable electronic controller 21 which is powered by a power connection 22 and/or by a suitable auxiliary power source, in the present example a battery 23. The controller 21 is connected by a line 24 to the carbon dioxide detector 20 to receive a signal dependent on the proportion of carbon dioxide in the air drawn in through the duct 18. The auxiliary power means 23 may comprise, in addition to or in place of the battery, other means such as a solar panel to generate power. The controller 21 may be operable to deactivate itself if the power available in the auxiliary power means has dropped below a particular level. The controller 21 may comprise a circuit of discrete components and/or a plurality of printed circuit boards and/or may run software stored in a ROM, a RAM, an ASIC, EPROM or otherwise as desired.

To allow for actuation and deactivation of the device, the controller 21 is provided with a control connection 21a. The control connection 21a may transmit activation and deactivation signals to the controller 21, for example from a control system 21b in the cab 11a of the tractor 11. Alternatively, as in the present example, the controller may be activated or deactivated by performing a sequence of operations using the brake lights, indicators, ignition and other systems as desired. The sequence of operations is received by the controller 21, for example via the control connection 21a. The controller may also transmit information on the control connection 21a, such as power level information, alarm status information or any other information as desired. The control connection 21a may instead comprise a wireless connection, such as a

radio or infra-red connection. Where it is desired to activate or deactivate the controller 21 separately from the cab 11a, for example where no tractor 11 is present, advantageously a handheld or portable device may be provided to activate or deactivate the controller 21.

The intrusion detector 12 is further provided with a suitable alarm, generally indicated at 25 and connected to the controller 21 by line 26. In this example, the alarm means 25 comprises an externally visible strobe light 27 and an audible siren 28, mounted internally within the case 14. Alternatively, or additionally, the intrusion detector 12 may be operable to transmit a message by any appropriate means to a suitable recipient alerting them to the intrusion. For example, a message may be transmitted by radio or by cellular radio telephone or by other means as desired to the police or to a vehicle control centre or to a personal communication device carried by the driver or otherwise. Where the intrusion detector 12 is provided with a wireless connection, either in place of the control connection 21a or as part of means of transmitting an alarm, status information may be made available where desired, for example to customs officials or other inspectors as desired.

In operation, when it is desired to protect the vehicle 10 against unauthorised intrusion, the intrusion detector 12 is activated. If the trailer 10 is connected to the tractor 11 and power is being supplied from the tractor 11 to the trailer 10, the intrusion detector 12 may draw power from the power connection 22, otherwise the intrusion detector will be powered from the auxiliary power source 23. Air from the compartment 10b is drawn in through the duct 18 by the fan 19 and passed over the carbon dioxide generator 20. To conserve power, it will be apparent that the fan 19 need not be operated continuously, but that the air in the compartment 10b may be tested at intervals, for example every 15 minutes and the fan 19 operated for the period of time necessary to take a sample. Alternatively, it may be possible to omit the fan 19 by mounting the carbon dioxide detector 20 such that sufficient air from the

compartment can be measured by the detector 20 without being actively drawn through the duct 18. The carbon dioxide detector 20 is responsive to the proportion of carbon dioxide in the air in the compartment 10b and is operable to generate an appropriate signal on line 24 to the controller 21. In the present example, the carbon dioxide sensor is able to detect the proportion of carbon dioxide in the compartment 10b in the range of 2500 ppm to 5000 ppm. When the level of carbon dioxide increases, this will be taken as an indication of a person entering the compartment 10b. The degree of increase in the proportion of carbon dioxide may be selected as appropriate to ensure that the controller generates an alarm when a person is present in the compartment 10b but while minimising "false positive" alarms. The increase may be an absolute value, such as 500 ppm, or a relative such as 20%, or otherwise as desired.

Alternatively, when the proportion of carbon dioxide in the chamber 10b exceeds a pre-selected level, in the present example at least 2500 ppm and in practise at least 2000 ppm and more preferably at least 3500 ppm, this will be deemed to be evidence of a person entering the compartment 10b and causing the level of carbon dioxide to rise by virtue of respiration of that person within the compartment 10b.

On detecting the intrusion, the controller 21 will activate the alarm 25, providing a visual and/or an audible warning and/or generating an alarm message as discussed above. The controller 21 will preferably "latch" so the alarm will continue to sound even if the carbon dioxide proportion in the compartment 10b falls below the selected level, and the case 14 is preferably sufficiently sturdy to avoid concerted physical attack or tampering to silence or otherwise interrupt the alarm 25.

When it is desired to legitimately enter the compartment 10b, the intrusion detector 12 may be deactivated.

In the present example, it is intended that the intrusion detector 12 will in a default state be active. Preferably, the intrusion detector 12 is operable to

become active when the ignition on the tractor 11 is operated even if the intrusion detector 12 has not been properly reactivated. To permit legitimate entry to the compartment 10b, for loading or inspection purposes, the intrusion detector 12 is deactivated by the driver by following a series of actions using the ignition, directional indicators and stop lights in the cab 11a. The timing and pattern of the actions will be monitored by control system 21b which may be a micro-processor, for example by algorithmic integration. It will be apparent that the control system 21b may then send a signal on the control connection 21a to active or deactivate the intrusion detector 12, or may send details of the actions performed on connection 21a to the controller 21, which may then decide to activate or deactivate the intrusion detector 12 itself on the basis of the received information.

A similar process of actions performed by the driver may be used to active the intrusion detector 12. Alternatively, it may be envisaged that the intrusion detector 12 will return to its active state after a set time period has elapsed unless the deactivation actions are performed again.

When it is desired to uncouple the trailer 10 from the tractor 11, a similar series of actions may be performed. By performing the appropriate series of actions, the driver may leave the intrusion device on the trailer in an activated or deactivated state as appropriate. It might be envisaged that if the tractor 11 and trailer 10 are separated without appropriate actions being performed, the controller 21 may detect the loss of signal on the control line 21a and may activate the alarm, for example as a response to what made an attempted theft of the tractor 10 or trailer 11.

The carbon dioxide detector 20 and controller 21 can be implemented as desired. For example, the carbon dioxide detector 20 may send a signal comprising a voltage which is proportional to the proportion of carbon dioxide detected in the air from the compartment 10b, and the controller 21 may activate the alarm 25 when that voltage passes a level set on the controller 21 or

when the voltage indicates an increase in the proportion of carbon dioxide in the air of the compartment above that set on the controller 21. Alternatively, the carbon dioxide detector 20 may be operable to pass a signal to the controller 21 only when the proportion of carbon dioxide in the air of the compartment 10b exceeds a pre-selected level set on the carbon dioxide detector 20 and the controller 21 may activate the alarm 25 in response to that signal. The proportion of carbon dioxide or increase in the proportion of carbon dioxide at which the alarm is activated may be set at the factory, or by adjustment means, for example a variable resistor or other appropriate means may be provided on the carbon dioxide detector 20 and/or controller 21. The proportion of carbon dioxide at which the alarm is activated should be selected in view of the normal conditions within the compartment 10b to avoid a false alarm, that is triggering the alarm when no intruder is present, but to ensure that the alarm is activated by the presence of an intruder without undue delay.

A further embodiment of an intrusion detector embodying the present invention will now be described with reference to Figures 5 to 7. An intrusion detector is generally indicated at 30 which comprises an outer part 31 having a back plate 32 which is attached to the external surface of a forward wall 10a of a trailer 10 and a cover 33. The cover 33 comprises cast aluminium in this example, although other materials may be used as desired. The cover 33 comprises cast aluminium in this example, although other materials may be used as desired. Threaded bolts 32a are provided on the back plate 32, for example by being bonded thereto. A second part 34 of the intrusion detector 30 is attached to the interior surface of the forward wall 10a of the trailer as best seen in Figure 6.

Mounted on the back plate 32 of the first part 31 is a sensor and fan assembly 35 including a fan 36. The fan 36 is operable to draw air through an air intake tube 37 which passes through the forward wall 10a and into the compartment 10b of the trailer 10. As seen in Figure 7 the second part 34

comprises a grille 38 to cover the end of the air intake tube 37. An electronic controller 39 is provided powered by a battery 40 connected to the sensor in the sensor assembly 35 and is operable in like manner to the electronic controller 21 of the embodiment of Figures 2 to 4. As in the previous embodiment the controller 39 may draw power from any appropriate source as desired, such as the tractor or from a solar panel or otherwise. In the present example the controller 39 may operate for 3 months when powered solely by the battery 40. To provide an alarm, the intrusion detector 30 has a strobe light 41 and a sounder 42 to generate visual and audible alarms. A grille at 43 in the external casing is located in front of the sounder 42, while an appropriate transparent or translucent lens 41a is provided in the cover 33 to be located over the strobe 41. An LED 44 is provided on the cover 33 to indicate the present status of intrusion detector 30, for example activated, deactivated, triggered, low power or any other status as required. The status may be shown by a blink code, colour or otherwise as desired.

The intrusion detector 30 further comprises an auxiliary sensor as shown at 45 in Figures 6 and 7 protected by a cover 45a. The auxiliary sensor 45 is an appropriate detector responsive to the presence of a person in the field of view of the detector, such as a PIR detector or microwave detector. The auxiliary sensor may be a PIR and/or microwave detector, of conventional type responsive to heat and/or movement as appropriate. The auxiliary sensor 45 is connected to the electronic controller 39 such that the electronic controller 39 is operable to activate an alarm in response to the sensor 45 detecting the presence of a person and/or the sensor in the sensor assembly 35 detecting an increase in the level of carbon dioxide in the compartment 10h as in the embodiment hereinbefore described. The auxiliary sensor 45 in the present example is connected to the controller 39 by wires (not shown) passing through the air intake tube 37, but may be connected otherwise as desired.

To fix the intrusion detector 30 in place eight apertures are provided in the end wall 10a to received the threaded bolts 32a and one aperture is provided to receive the air intake tube 37. Shear bolts 34a having an internally threaded part pass through the second part 34 and engage the threaded bolts 32a to firmly attach the back plate 32 and second part 34.

The first part 31 is provided with an appropriate detector to detect when the cover 33 is removed, for example by providing a micro switch on the back plate 32 located to engage the cover 33 when the cover is in place, and connected to the electronic controller 39 such that the electronic controller 39 may activate an alarm in response to the cover 33 being removed. Further antitamper precautions may be taken as desired. For example, the electronic controller 59 may be responsive to external connections being broken, for example any external wires being cut. If someone attempts to interfere with the fan 36 or air intake tube 37, for example by inserting an object to jam the fan 36 or by covering the end of the air intake tube 37, the electronic controller may detect the increased resistance to turning of the fan 36, for example by measuring the current drawn by the fan motor, and generate an alarm accordingly. Likewise the auxiliary sensor 45 may be provided with antitamper precautions, to detect for example attempted removal of the cover 45a or cutting the connection between the auxiliary sensor 45 and the controller 39, or any other attempt to tamper with the sensor 45 as desired.

In both embodiments of intrusion detectors described hereinbefore, a connection is provided from the intrusion detector 12, 30 to the wiring loom (not shown) of the trailer 10 so that the electronic controller 12, 39 can detect the operation of the brake lights, indicators, ignition and other operation as required to activate or deactivate the intrusion detector 12, 30.

It will be apparent that the invention may be used with any appropriate vehicle as desired such as a rigid vehicle, as well as an articulated vehicle as shown in the figures.

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In the present specification "comprises" means "includes or consists of" and "comprising" means "including or consisting of".

The features disclosed in the foregoing description, or the following claims, or the accompanying drawings, expressed in their specific forms or in terms of a means for performing the disclosed function, or a method or process for attaining the disclosed result, as appropriate, may, separately, or in any combination of such features, be utilised for realising the invention in diverse forms thereof.

CLAIMS

1. An intrusion detector for the vehicle, the detector being attachable to the vehicle, wherein the intrusion detector comprises a carbon dioxide detector responsive to the presence of carbon dioxide in a compartment of the vehicle, and wherein the intrusion detector is responsive to the proportion of carbon dioxide in the compartment and is operable to generate an alarm in accordance with the proportion of carbon dioxide in the compartment.
2. An intrusion detector according to claim 1 wherein the vehicle comprises a trailer for a tractor-trailer combination.
3. An intrusion detector according to claim 1 or claim 2 wherein the intrusion detector is adapted to be mounted on the exterior of the vehicle and wherein a duct is provided whereby air from the compartment may be passed to the carbon dioxide detector.
4. An intrusion detector according to claim 3 wherein a fan is provided to pass air from the compartment to the carbon dioxide detector.
5. An intrusion detector according to any one of the preceding claims connectable to power supply of the vehicle and further comprising a battery which may be charged by the power supply.
6. An intrusion detector according to any one of the preceding claims wherein the intrusion detector is operable to generate an alarm if the proportion of carbon dioxide in the compartment rises by a selected proportion or amount.

7. An intrusion detector according to any one of claims 1 to 5 wherein the intrusion detector is operable to generate an alarm if the proportion of carbon dioxide in the compartment exceeds a selected level.
8. An intrusion detector according to claim 7 wherein in the selected level of carbon dioxide is at least 2500 ppm, and preferably at least 3500 ppm, most preferably at least 2000 ppm.
9. An intrusion detector according to any one of the preceding claims wherein the alarm comprises at least one of an audible alarm, a visual alarm, and the transmission of an alarm message.
10. An intrusion detector according to any one of the preceding claims further comprising an auxiliary detector responsive to the presence of a person to the compartment.
11. An intrusion detector according to claim 10 wherein the auxiliary detector comprises a PIR detector or a microwave director.
12. An intrusion detector substantially as hereinbefore described with reference to and as shown in the accompanying drawings.
13. A vehicle comprising an intrusion detector according to any one of the preceding claims.
14. A vehicle according to claim 13 wherein the vehicle comprises a trailer and wherein the intrusion detector is mounted on a outer surface of the vehicle.

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15. A vehicle according to claim 14 where dependent directly or indirectly on claim 10 wherein the auxiliary detector is mounted in the compartment.
16. A vehicle substantially as hereinbefore described with reference to and as shown in the accompanying drawings.
17. Any novel feature or novel combination of features described herein and/or in the accompanying drawings.

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ABSTRACT

Title: Intrusion Detector

An intrusion detector for the vehicle, the detector being attachable to the vehicle, wherein the intrusion detector comprises a carbon dioxide detector responsive to the presence of carbon dioxide in a compartment of the vehicle, and wherein the intrusion detector is operable to generate an alarm if the proportion of carbon dioxide in the volume exceeds a selected level.

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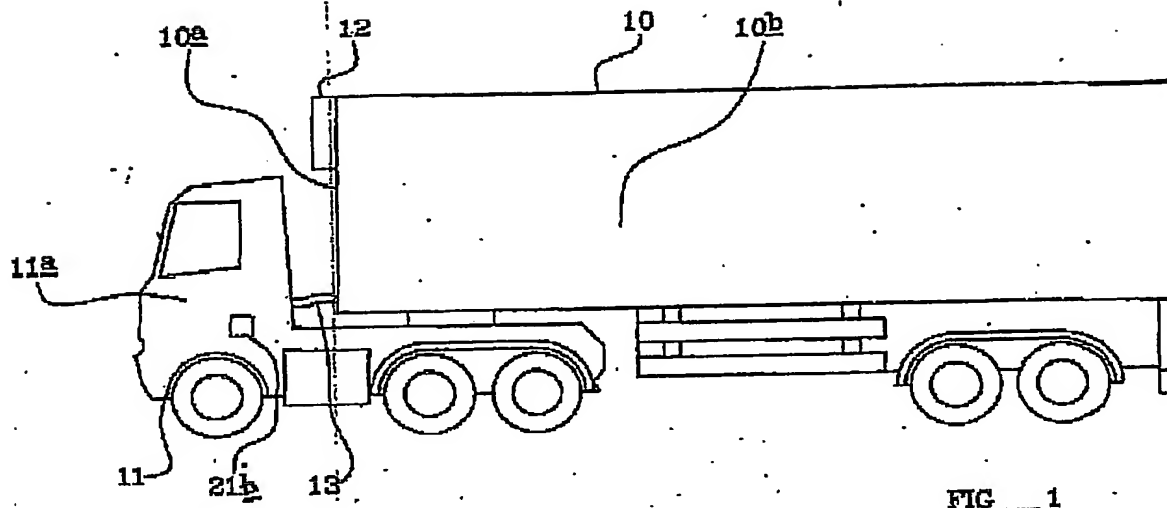


FIG. 1

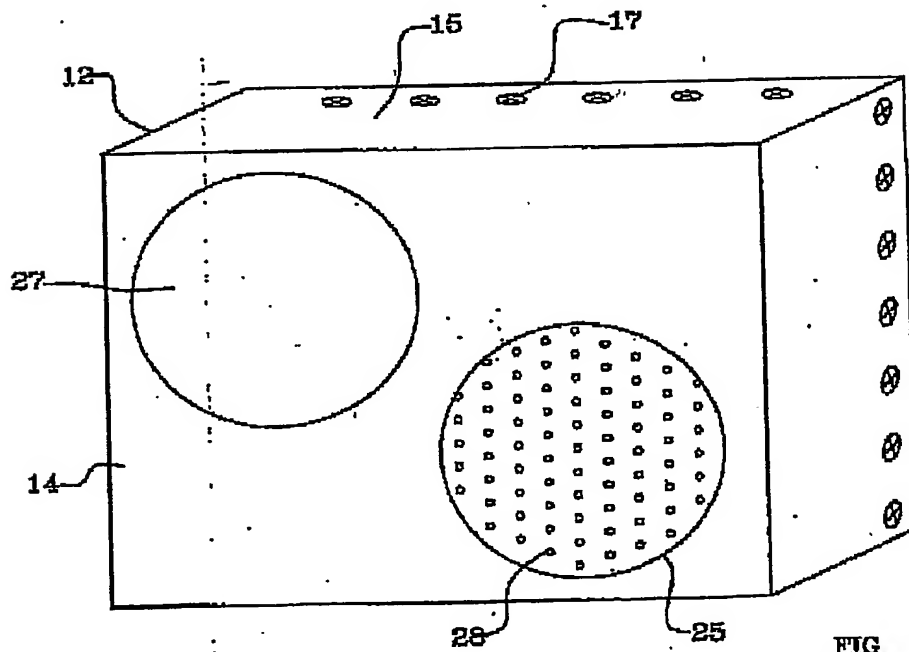
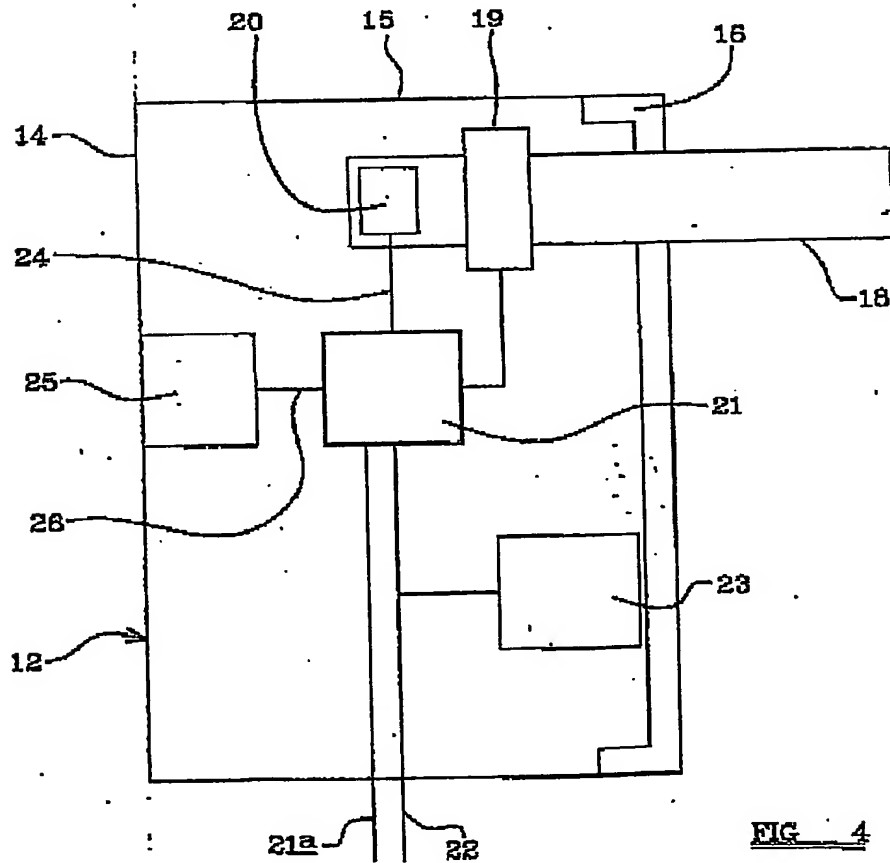
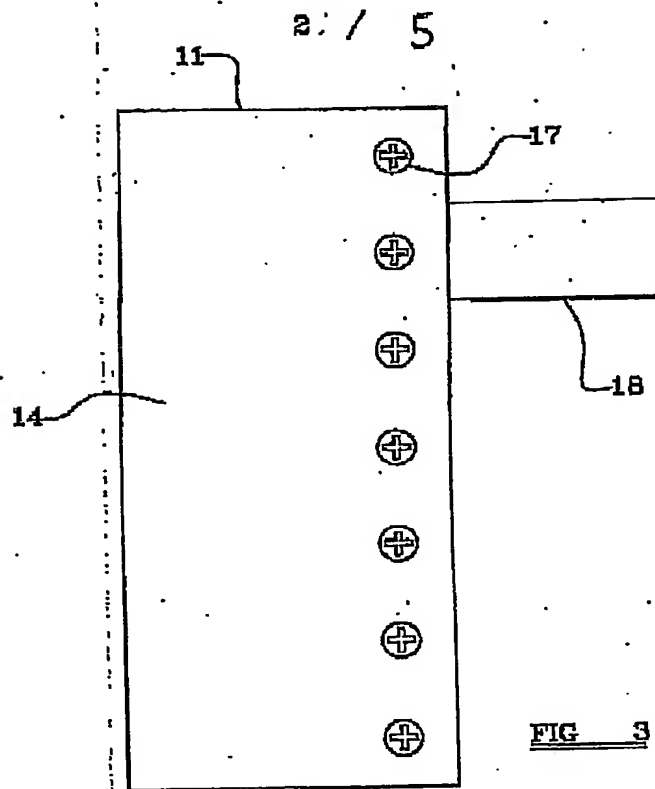
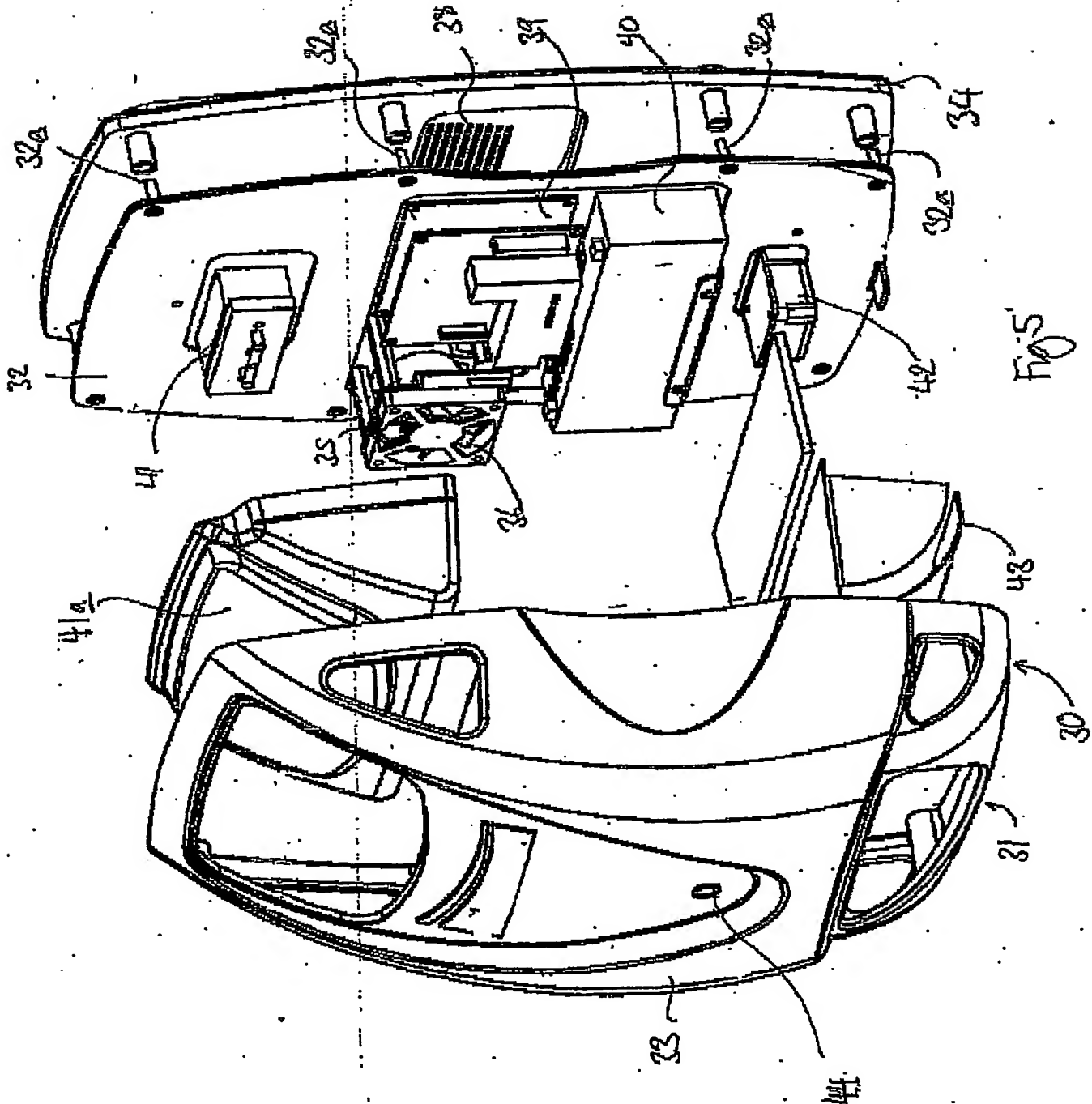


FIG. 2



$$3\sqrt{5}$$


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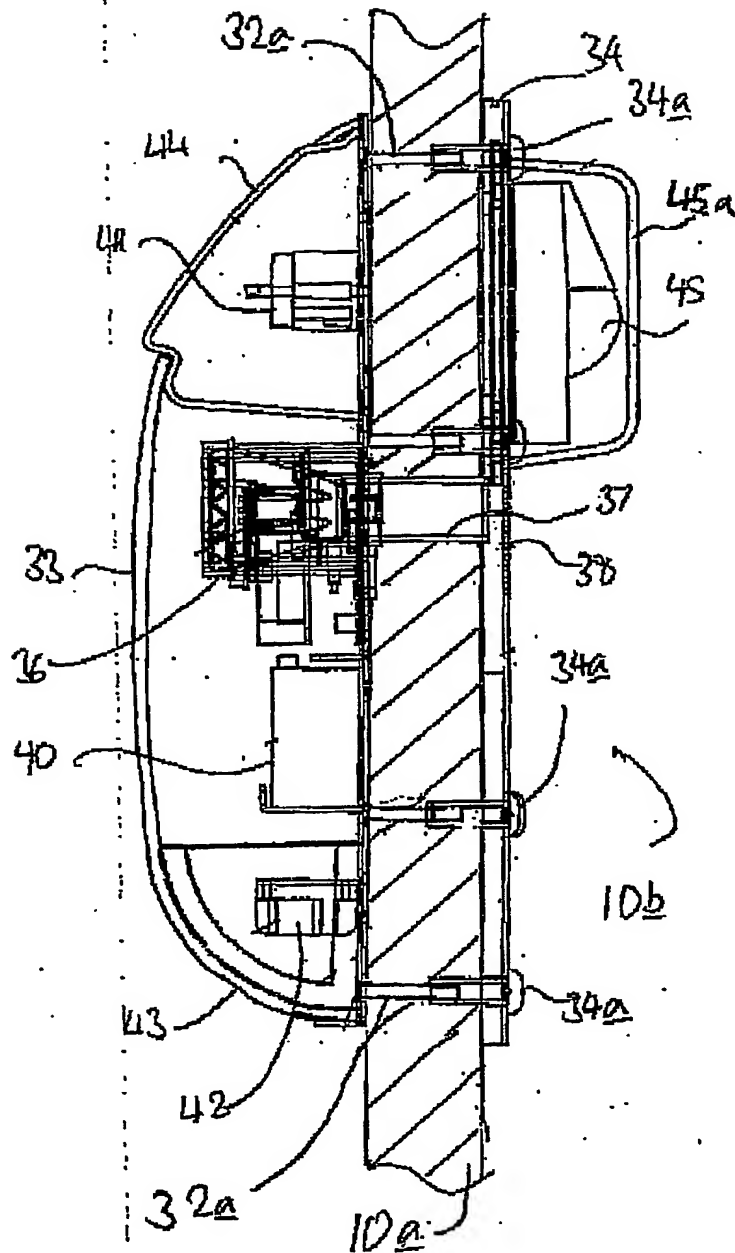


Fig 6

s/s

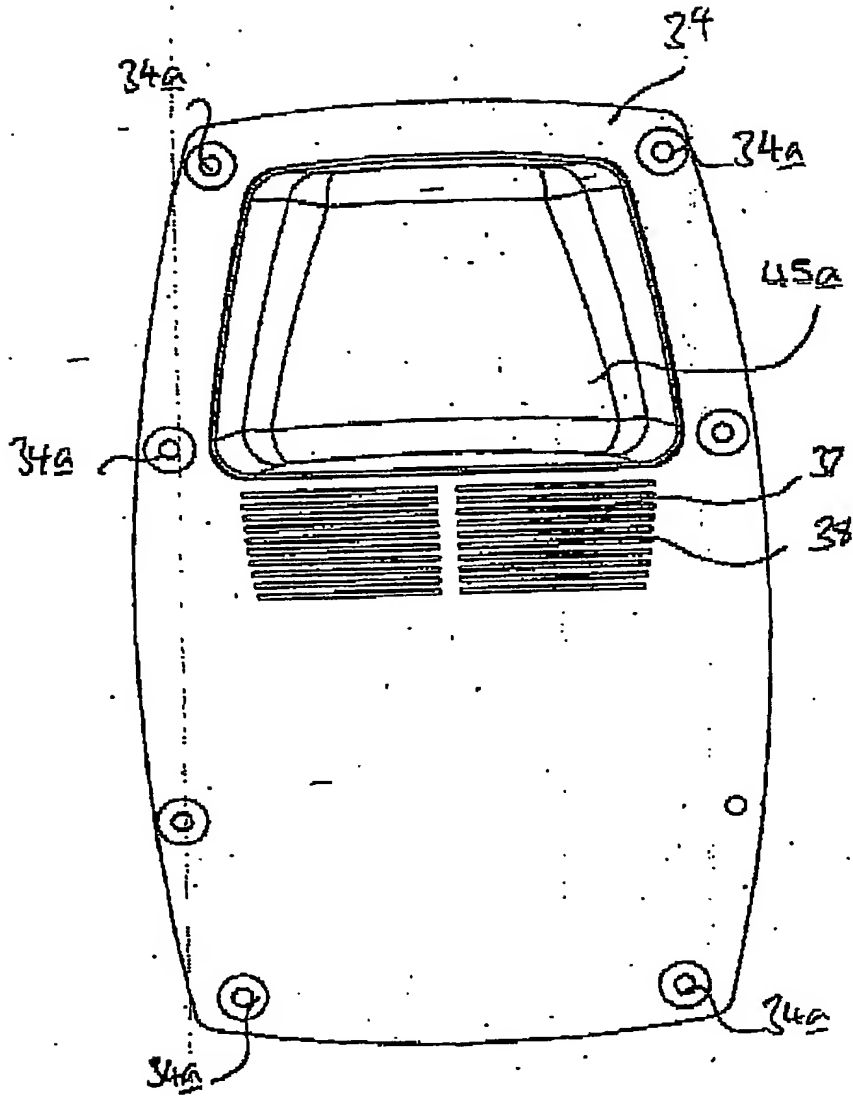


Fig 7

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